Package ‘MOTE’

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Title Effect Size and Confidence Interval Calculator

Depends R (>= 3.1.0)

Imports MBESS, stats, ez, reshape

Description Measure of the Effect ('MOTE') is an effect size calculator, including a wide variety of effect sizes in the mean differences family (all versions of d) and the variance overlap family (eta, omega, epsilon, r). 'MOTE' provides non-central confidence intervals for each effect size, relevant test statistics, and output for reporting in APA Style (American Psychological Association, 2010, <ISBN:1433805618>) with 'LaTeX'. In research, an over-reliance on p-values may conceal the fact that a study is under-powered (Halsey, Curran-Everett, Vowler, & Drummond, 2015 <doi:10.1038/nmeth.3288>). A test may be statistically significant, yet practically inconsequential (Fritz, Scherndl, & Kühberger, 2012 <doi:10.1177/0959354312436870>). Although the American Psychological Association has long advocated for the inclusion of effect sizes (Wilkinson & American Psychological Association Task Force on Statistical Inference, 1999 <doi:10.1037/0003-066X.54.8.594>), the vast majority of peer-reviewed, published academic studies stop short of reporting effect sizes and confidence intervals (Cumming, 2013, <doi:10.1177/0956797613504966>). 'MOTE' simplifies the use and interpretation of effect sizes and confidence intervals. For more information, visit <https://www.aggieerin.com/shiny-server>.

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apa — *APA Format*

Description

A function that formats decimals and leading zeroes for creating reports in scientific style.

Usage

```
apa(value, decimals = 3, leading = TRUE)
```

Arguments

`value`	A set of numeric values, either a single number, vector, or set of columns.
`decimals`	The number of decimal points desired in the output.
`leading`	Logical value: `TRUE` for leading zeroes on decimals and `FALSE` for no leading zeroes on decimals. The default is `TRUE`.

Details

This function creates "pretty" character vectors from numeric variables for printing as part of a report. The value can take a single number, matrix, vector, or multiple columns from a data frame, as long as they are numeric. The values will be coerced into numeric if they are characters or logical values, but this process may result in an error if values are truly alphabetical.

Examples

```
apa(value = 0.54674, decimals = 3, leading = TRUE)
```

bn1_data — *Between Subjects One-way ANOVA Example Data*

Description

Dataset for use in `eta.F`, `eta.full.SS`, `omega.F`, `omega.full.SS`, and `epsilon.full.SS`, including ratings of inter-personal attachments of 45-year-olds categorized as being in excellent, fair, or poor health.

Usage

```
data(bn1_data)
```

Format

A data frame of ratings of close interpersonal attachments

poor: individuals in poor health fair: individuals in fair health excellent: individuals in excellent health

References

Nolan and Heizen Statistics for the Behavioral Sciences (Book Link)

`bn2_data` *Between Subjects Two-way ANOVA Example Data*

Description

Dataset for use in `omega.partial.SS.bn`, `eta.partial.SS`, and other between-subject's ANOVA designs. This data includes (fake) atheletic budgets for baseball, basketball, football, soccer, and volleyball teams with new and old coaches to determine if there are differences in spending across coaches and sports.

Usage

```
data(bn2_data)
```

Format

A data frame of ratings of close interpersonal attachments

coach: an old or new coach type: varying sports - baseball, basketball, football, soccer, volleyball money: athletic spending (in thousands of dollars)

`chisq_data` *Chi-Square Example Data*

Description

Dataset for use in `v.chi.sq`, Individuals were polled and asked to report their number of friends (low, medium, high) and number of kids (1, 2, 3+) to determine if there was a relationship between friend groups and number of children. It was hypothesized that those with more children may have less time for friendship maintaining activities.

Usage

```
data(chisq_data)
```

Format

A data frame of number of friends and number of children

friends: number of reported friends kids: number of children

References

Nolan and Heizen Statistics for the Behavioral Sciences (Book Link) `d.dep.t.avg` *d for Dependent t with Average SD Denominator*

Description

This function displays d and the non-central confidence interval for repeated measures data, using the average standard deviation of each level as the denominator.

Usage

```
d.dep.t.avg(m1, m2, sd1, sd2, n, a = 0.05)
```

Arguments

`m1`	mean from first level
`m2`	mean from second level
`sd1`	standard deviation from first level
`sd2`	standard deviation from second level
`n`	sample size
`a`	significance level

Details

To calculate d, mean two is subtracted from mean one, which is then divided by the average standard deviation.

d_av = (m1 - m2) / ((sd1 + sd2) / 2)

Learn more on our example page.

Value

The effect size (Cohen's d) with associated confidence intervals, the confidence intervals associated with the means of each group, standard deviations of the means for each group.

`d`	effect size
`dlow`	lower level confidence interval d value
`dhigh`	upper level confidence interval d value
`M1/M2`	mean one and two
`M1low/M2low`	lower level confidence interval of mean one or two
`M1high/M2high`	upper level confidence interval of mean one or two
`sd1/sd2`	standard deviation of mean one and two
`se1/se2`	standard error of mean one and two
`n`	sample size
`df`	degrees of freedom (sample size - 1)
`estimate`	the d statistic and confidence interval in APA style for markdown printing

Examples

```
#The following example is derived from the "dept_data" dataset included
#in the MOTE library.

#In a study to test the effects of science fiction movies on people's
#belief in the supernatural, seven people completed a measure of belief
#in the supernatural before and after watching a popular science fiction
#movie. Higher scores indicated higher levels of belief.

    t.test(dept_data$before, dept_data$after, paired = TRUE)

#You can type in the numbers directly, or refer to the dataset,
#as shown below.

    d.dep.t.avg(m1 = 5.57, m2 = 4.43, sd1 = 1.99,
                sd2 = 2.88, n = 7, a = .05)

    d.dep.t.avg(5.57, 4.43, 1.99, 2.88, 7, .05)

    d.dep.t.avg(mean(dept_data$before), mean(dept_data$after),
                sd(dept_data$before), sd(dept_data$after),
                length(dept_data$before), .05)

#The mean measure of belief on the pretest was 5.57, with a standard
#deviation of 1.99. The posttest scores appeared lower (M = 4.43, SD = 2.88)
#but the dependent t-test was not significant using alpha = .05,
#t(7) = 1.43, p = .203, d_av = 0.47. The effect size was a medium effect suggesting
#that the movie may have influenced belief in the supernatural.
```

`d.dep.t.diff` *d for Dependent t with SD Difference Scores Denominator*

Description

This function displays d and the non-central confidence interval for repeated measures data, using the standard deviation of the difference score as the denominator.

Usage

```
d.dep.t.diff(mdiff, sddiff, n, a = 0.05)
```

Arguments

`mdiff`	mean difference score
`sddiff`	standard deviation of the difference scores
`n`	sample size
`a`	significance level

Details

To calculate d, the mean difference score is divided by divided by the standard deviation of the difference scores.

d_z = mdiff / sddiff

Learn more on our example page.

Value

The effect size (Cohen's d) with associated confidence intervals, mean differences with associated confidence intervals, standard deviation of the differences, standard error, sample size, degrees of freedom, the t-statistic, and the p-value.

`d`	effect size
`dlow`	lower level confidence interval d value
`dhigh`	upper level confidence interval d value
`mdiff`	mean difference score
`Mlow`	lower level of confidence interval of the mean
`Mhigh`	upper level of confidence interval of the mean
`sddiff`	standard deviation of the difference scores
`n`	sample size
`df`	degrees of freedom (sample size - 1)
`t`	t-statistic
`p`	p-value
`estimate`	the d statistic and confidence interval in APA style for markdown printing
`statistic`	the t-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "dept_data" dataset included
#in the MOTE library.

#In a study to test the effects of science fiction movies on people's
#belief in the supernatural, seven people completed a measure of belief
#in the supernatural before and after watching a popular science fiction movie.
#Higher scores indicated higher levels of belief. The mean difference score was 1.14,
#while the standard deviation of the difference scores was 2.12.

#You can type in the numbers directly as shown below,
#or refer to your dataset within the function.

    d.dep.t.diff(mdiff = 1.14, sddiff = 2.12, n = 7, a = .05)

    d.dep.t.diff(1.14, 2.12, 7, .05)

    d.dep.t.diff(mdiff = mean(dept_data$before - dept_data$after),
```

```
                 sddiff = sd(dept_data$before - dept_data$after),
                 n = length(dept_data$before),
                 a = .05)

#The mean measure of belief on the pretest was 5.57, with a standard
#deviation of 1.99. The posttest scores appeared lower (M = 4.43, SD = 2.88)
#but the dependent t-test was not significant using alpha = .05,
#t(7) = 1.43, p = .203, d_z = 0.54. The effect size was a medium
#effect suggesting that the movie may have influenced belief
#in the supernatural.
```

`d.dep.t.diff.t` *d from t for Repeated Measures with SD Difference Scores Denominator*

Description

This function displays d for repeated measures data and the non-central confidence interval using the standard deviation of the differences as the denominator estimating from the t-statistic.

Usage

```
d.dep.t.diff.t(t, n, a = 0.05)
```

Arguments

`t`	t-test value
`n`	sample size
`a`	significance level

Details

To calculate d, the t-statistic is divided by the square root of the sample size.

d_z = t / sqrt(n)

Learn more on our example page.

Value

`d`	effect size
`dlow`	lower level confidence interval d value
`dhigh`	upper level confidence interval d value
`n`	sample size
`df`	degrees of freedom (sample size - 1)
`p`	p-value
`estimate`	the d statistic and confidence interval in APA style for markdown printing
`statistic`	the t-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "dept_data" dataset included
#in the MOTE library.

#In a study to test the effects of science fiction movies on people's belief
#in the supernatural, seven people completed a measure of belief in
#the supernatural before and after watching a popular science
#fiction movie. Higher scores indicated higher levels of belief.

    scifi = t.test(dept_data$before, dept_data$after, paired = TRUE)

#The t-test value was 1.43. You can type in the numbers directly,
#or refer to the dataset, as shown below.

    d.dep.t.diff.t(t = 1.43, n = 7, a = .05)

    d.dep.t.diff.t(1.43, 7, .05)

    d.dep.t.diff.t(scifi$statistic, length(dept_data$before), .05)

#The mean measure of belief on the pretest was 5.57, with a standard
#deviation of 1.99. The posttest scores appeared lower (M = 4.43, SD = 2.88)
#but the dependent t-test was not significant using alpha = .05,
#t(7) = 1.43, p = .203, d_z = 0.54. The effect size was a medium effect suggesting
#that the movie may have influenced belief in the supernatural.
```

`d.dep.t.rm` *d for Repeated Measures with Average SD Denominator*

Description

This function displays d and the non-central confidence interval for repeated measures data, using the average standard deviation of each level as the denominator, but controlling for r.

Usage

```
d.dep.t.rm(m1, m2, sd1, sd2, r, n, a = 0.05)
```

Arguments

`m1`	mean from first level
`m2`	mean from second level
`sd1`	standard deviation from first level
`sd2`	standard deviation from second level
`r`	correlation between first and second level
`n`	sample size
`a`	significance level

Details

To calculate d, mean two is subtracted from mean one, which is divided by the average standard deviation, while mathematically controlling for the correlation coefficient (r).

d_rm = ((m1 - m2) / sqrt((sd1^2 + sd2^2) - (2 x r x sd1 x sd2))) x sqrt(2 x (1-r))

Learn more on our example page.

Value

Controls for correlation and provides the effect size (Cohen's d) with associated confidence intervals,m the confidence intervals associated with the means of each group,mstandard deviations and standard errors of the means for each group.

d	effect size
dlow	lower level confidence interval d value
dhigh	upper level confidence interval d value
M1	mean one
sd1	standard deviation of mean one
se1	standard error of mean one
M1low	lower level confidence interval of mean one
M1high	upper level confidence interval of mean one
M2	mean two
sd2	standard deviation of mean two
se2	standard error of mean two
M2low	lower level confidence interval of mean two
M2high	upper level confidence interval of mean two
r	correlation
n	sample size
df	degrees of freedom (sample size - 1)
estimate	the d statistic and confidence interval in APA style for markdown printing

Examples

```
#The following example is derived from the "dept_data" dataset included
#in the MOTE library.

#In a study to test the effects of science fiction movies on people's
#belief in the supernatural, seven people completed a measure of belief
#in the supernatural before and after watching a popular science fiction
#movie. Higher scores indicated higher levels of belief.

    t.test(dept_data$before, dept_data$after, paired = TRUE)

    scifi_cor = cor(dept_data$before, dept_data$after, method = "pearson",
```

```
                use = "pairwise.complete.obs")

#You can type in the numbers directly, or refer to the dataset,
#as shown below.

    d.dep.t.rm(m1 = 5.57, m2 = 4.43, sd1 = 1.99,
                sd2 = 2.88, r = .68, n = 7, a = .05)

    d.dep.t.rm(5.57, 4.43, 1.99, 2.88, .68, 7, .05)

    d.dep.t.rm(mean(dept_data$before), mean(dept_data$after),
                sd(dept_data$before), sd(dept_data$after),
                scifi_cor, length(dept_data$before), .05)

#The mean measure of belief on the pretest was 5.57, with a standard
#deviation of 1.99. The posttest scores appeared lower (M = 4.43, SD = 2.88)
#but the dependent t-test was not significant using alpha = .05,
#t(7) = 1.43, p = .203, d_rm = 0.43. The effect size was a medium effect suggesting
#that the movie may have influenced belief in the supernatural.
```

d.ind.t — *d for Between Subjects with Pooled SD Denominator*

Description

This function displays d for between subjects data and the non-central confidence interval using the pooled standard deviation as the denominator.

Usage

```
d.ind.t(m1, m2, sd1, sd2, n1, n2, a = 0.05)
```

Arguments

m1	mean group one
m2	mean group two
sd1	standard deviation group one
sd2	standard deviation group two
n1	sample size group one
n2	sample size group two
a	significance level

Details

To calculate d, mean two is subtracted from mean one and divided by the pooled standard deviation.

d_s = (m1 - m2) / spooled

Learn more on our example page.

Value

Provides the effect size (Cohen's d) with associated confidence intervals, the t-statistic, the confidence intervals associated with the means of each group, as well as the standard deviations and standard errors of the means for each group.

`d`	effect size
`dlow`	lower level confidence interval of d value
`dhigh`	upper level confidence interval of d value
`M1`	mean of group one
`sd1`	standard deviation of group one mean
`se1`	standard error of group one mean
`M1low`	lower level confidence interval of group one mean
`M1high`	upper level confidence interval of group one mean
`M2`	mean of group two
`sd2`	standard deviation of group two mean
`se2`	standard error of group two mean
`M2low`	lower level confidence interval of group two mean
`M2high`	upper level confidence interval of group two mean
`spooled`	pooled standard deviation
`sepooled`	pooled standard error
`n1`	sample size of group one
`n2`	sample size of group two
`df`	degrees of freedom (n1 - 1 + n2 - 1)
`t`	t-statistic
`p`	p-value
`estimate`	the d statistic and confidence interval in APA style for markdown printing
`statistic`	the t-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "indt_data" dataset, included
#in the MOTE library.

#A forensic psychologist conducted a study to examine whether
#being hypnotized during recall affects how well a witness
#can remember facts about an event. Eight participants
#watched a short film of a mock robbery, after which
#each participant was questioned about what he or she had
#seen. The four participants in the experimental group
#were questioned while they were hypnotized. The four
#participants in the control group recieved the same
#questioning without hypnosis.
```

```
    t.test(correctq ~ group, data = indt_data)

#You can type in the numbers directly, or refer to the dataset,
#as shown below.

    d.ind.t(m1 = 17.75, m2 = 23, sd1 = 3.30,
           sd2 = 2.16, n1 = 4, n2 = 4, a = .05)

    d.ind.t(17.75, 23, 3.30, 2.16, 4, 4, .05)

    d.ind.t(mean(indt_data$correctq[indt_data$group == 1]),
            mean(indt_data$correctq[indt_data$group == 2]),
            sd(indt_data$correctq[indt_data$group == 1]),
            sd(indt_data$correctq[indt_data$group == 2]),
            length(indt_data$correctq[indt_data$group == 1]),
            length(indt_data$correctq[indt_data$group == 2]),
            .05)

#Contrary to the hypothesized result, the group that underwent hypnosis were
#significantly less accurate while reporting facts than the control group
#with a large effect size, t(6) = -2.66, p = .038, d_s = 1.88.
```

`d.ind.t.t` *d from t for Between Subjects*

Description

This function displays d for between subjects data and the non-central confidence interval estimating from the t-statistic.

Usage

```
d.ind.t.t(t, n1, n2, a = 0.05)
```

Arguments

`t`	t-test value
`n1`	sample size group one
`n2`	sample size group two
`a`	significance level

Details

To calculate d, the t-statistic is multiplied by two then divided by the square root of the degrees of freedom.

d_s = 2 * t / sqrt(n1 + n2 - 2)

Learn more on our example page.

Value

Provides the effect size (Cohen's d) with associated confidence intervals, degrees of freedom, t-statistic, and p-value.

`d`	effect size
`dlow`	lower level confidence interval of d value
`dhigh`	upper level confidence interval of d value
`n1`	sample size
`n2`	sample size
`df`	degrees of freedom (n1 - 1 + n2 - 1)
`t`	t-statistic
`p`	p-value
`estimate`	the d statistic and confidence interval in APA style for markdown printing
`statistic`	the t-statistic in APA for the t-test

Examples

```
#The following example is derived from the "indt_data" dataset, included
#in the MOTE library.

#A forensic psychologist conducted a study to examine whether
#being hypnotized during recall affects how well a witness
#can remember facts about an event. Eight participants
#watched a short film of a mock robbery, after which
#each participant was questioned about what he or she had
#seen. The four participants in the experimental group
#were questioned while they were hypnotized. The four
#participants in the control group recieved the same
#questioning without hypnosis.

    hyp = t.test(correctq ~ group, data = indt_data)

#You can type in the numbers directly, or refer to the dataset,
#as shown below.

    d.ind.t.t(t = -2.6599, n1 = 4, n2 = 4, a = .05)

    d.ind.t.t(-2.6599, 4, 4, .05)

    d.ind.t.t(hyp$statistic,
              length(indt_data$group[indt_data$group == 1]),
              length(indt_data$group[indt_data$group == 2]),
              .05)

#Contrary to the hypothesized result, the group that underwent hypnosis were
#significantly less accurate while reporting facts than the control group
#with a large effect size, t(6) = -2.66, p = .038, d_s = 2.17.
```

d.prop — *d for Independent Proportions*

Description

This function displays d and central confidence interval calculated from differences in independent proportions. Independent proportions are two percentages that are from different groups of participants.

Usage

```
d.prop(p1, p2, n1, n2, a = 0.05)
```

Arguments

`p1`	proportion for group one
`p2`	proportion for group two
`n1`	sample size group one
`n2`	sample size group two
`a`	significance level

Details

To calculate z, the proportion of group two is substracted from group one, which is then divided by the standard error.

z = (p1 - p2) / se

To calculate d, the proportion of group two is divided by the standard error of group two which is then subtracted from the proportion of group one divided by the standard error of group one.

z1 = p1 / se1

z2 = p2 / se2

d = z1 - z2

Learn more on our example page.

Value

`d`	effect size
`dlow`	lower level confidence interval d value
`dhigh`	upper level confidence interval d value
`p1`	proportion of group one
`se1`	standard error of the proportion of group one
`z1`	z-statistic group one
`z1low`	lower level confidence interval of z

z1high	upper level confidence interval of z
p2	proportion of group two
se2	standard error of the proportion of group two
z2	z-statistic of group two
z2low	lower level confidence interval of z
z2high	upper level confidence interval of z
n1	sample size group one
n2	sample size group two
z	z-statistic for the differences
ppooled	pooled proportion to calculate standard error
se	standard error
p	p-value for the differences
estimate	the d statistic and confidence interval in APA style for markdown printing
statistic	the t-statistic in APA style for markdown printing

Examples

```
#Several researchers were examining the data on the number
#of students who retake a course after they receive a D, F,
#or withdraw from the course. They randomly sampled form
#a large university two groups of students: traditional
#(less than 25 years old) and non-traditional (25 and older).
#Each group included 100 participants. About 25% of students
#of the traditional group reported they would retake a course,
#while the non-traditional group showed about 35% would
#retake the course.

#You can type in the numbers directly as shown below,
#or refer to your dataset within the function.

    d.prop(p1 = .25, p2 = .35, n1 = 100, n2 = 100, a = .05)

    d.prop(.25, .35, 100, 100, .05)
```

---

d.single.t *d for Single t from Means*

Description

This function displays d and non-central confidence interval for single t from means.

Usage

```
d.single.t(m, u, sd, n, a = 0.05)
```

Arguments

`m`	sample mean
`u`	population mean
`sd`	sample standard deviation
`n`	sample size
`a`	significance level

Details

To calculate d, the population is subtracted from the sample mean, which is then divided by the standard deviation.

d = (m - u) / sd

Learn more on our example page.

Value

`d`	effect size
`dlow`	lower level confidence interval d value
`dhigh`	upper level confidence interval d value
`m`	sample mean
`sd`	standard deviation of the sample
`se`	standard error of the sample
`Mlow`	lower level confidence interval of the sample mean
`Mhigh`	upper level confidence interval of the sample mean
`u`	population mean
`n`	sample size
`df`	degrees of freedom (n - 1)
`t`	t-statistic
`p`	p-value
`estimate`	the d statistic and confidence interval in APA style for markdown printing
`statistic`	the t-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "singt_data" dataset included
#in the MOTE library.

#A school has a gifted/honors program that they claim is
#significantly better than others in the country. The gifted/honors
#students in this school scored an average of 1370 on the SAT,
#with a standard deviation of 112.7, while the national average
#for gifted programs is a SAT score of 1080.
```

```
    gift = t.test(singt_data, mu = 1080, alternative = "two.sided")

#You can type in the numbers directly as shown below,
#or refer to your dataset within the function.

    d.single.t(m = 1370, u = 1080, sd = 112.7, n = 14, a = .05)

    d.single.t(1370, 1080, 112.7, 100, .05)

    d.single.t(gift$estimate, gift$null.value,
            sd(singt_data$SATscore),
        length(singt_data$SATscore), .05)
```

`d.single.t.t` *d for Single t from t*

Description

This function displays d and non-central confidence interval for single t estimated from the t-statistic.

Usage

```
d.single.t.t(t, n, a = 0.05)
```

Arguments

`t`	t-test value
`n`	sample size
`a`	significance level

Details

To calculate d, the t-statistic is divided by the square root of the sample size.

d = t / sqrt(n)

Learn more on our example page.

Value

The effect size (Cohen's d) with associated confidence intervals and relevant statistics.

`d`	effect size
`dlow`	lower level confidence interval d value
`dhigh`	upper level confidence interval d value
`n`	sample size

df	degrees of freedom (sample size - 1)
t	sig stats
p	p-value
estimate	the d statistic and confidence interval in APA style for markdown printing
statistic	the t-statistic in APA style for markdown printing

Examples

```
#A school has a gifted/honors program that they claim is
#significantly better than others in the country. The gifted/honors
#students in this school scored an average of 1370 on the SAT,
#with a standard deviation of 112.7, while the national average
#for gifted programs is a SAT score of 1080.

    gift = t.test(singt_data, mu = 1080, alternative = "two.sided")

#According to a single-sample t-test, the scores of the students
#from the program were significantly higher than the national
#average, t(14) = 9.97, p < .001.

#You can type in the numbers directly as shown below, or refer
#to your dataset within the function.

    d.single.t.t(t = 9.968, n = 15, a = .05)

    d.single.t.t(9.968, 15, .05)

    d.single.t.t(gift$statistic, length(singt_data$SATscore), .05)
```

---

d.to.r *r and Coefficient of Determination (R2) from d*

Description

Calculates r from d and then translates r to r2 to calculate the non-central confidence interval for r2 using the F distribution.

Usage

```
d.to.r(d, n1, n2, a = 0.05)
```

Arguments

d	effect size statistic
n1	sample size group one
n2	sample size group two
a	significance level

Details

The correlation coefficient (r) is calculated by dividing Cohen's d by the square root of the total sample size squared - divided by the product of the sample sizes of group one and group two.

r = d / sqrt(d^2 + (n1 + n2)^2 / (n1*n2))

Learn more on our example page.

Value

Provides the effect size (correlation coefficient) with associated confidence intervals, the t-statistic, F-statistic, and other estimates appropriate for d to r translation. Note this CI is not based on the traditional r-to-z transformation but rather non-central F using the ci.R function from MBESS.

`r`	correlation coefficient
`rlow`	lower level confidence interval r
`rhigh`	upper level confidence interval r
`R2`	coefficient of determination
`R2low`	lower level confidence interval of R2
`R2high`	upper level confidence interval of R2
`se`	standard error
`n`	sample size
`dfm`	degrees of freedom of mean
`dfe`	degrees of freedom error
`t`	t-statistic
`F`	F-statistic
`p`	p-value
`estimate`	the r statistic and confidence interval in APA style for markdown printing
`estimateR2`	the R^2 statistic and confidence interval in APA style for markdown printing
`statistic`	the t-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "indt_data" dataset, included
#in the MOTE library.

#A forensic psychologist conducted a study to examine whether
#being hypnotized during recall affects how well a witness
#can remember facts about an event. Eight participants
#watched a short film of a mock robbery, after which
#each participant was questioned about what he or she had
#seen. The four participants in the experimental group
#were questioned while they were hypnotized. The four
#participants in the control group recieved the same
#questioning without hypnosis.
```

```
    t.test(correctq ~ group, data = indt_data)

#You can type in the numbers directly, or refer to the dataset,
#as shown below.

    d.ind.t(m1 = 17.75, m2 = 23, sd1 = 3.30,
           sd2 = 2.16, n1 = 4, n2 = 4, a = .05)

    d.ind.t(17.75, 23, 3.30, 2.16, 4, 4, .05)

    d.ind.t(mean(indt_data$correctq[indt_data$group == 1]),
            mean(indt_data$correctq[indt_data$group == 2]),
            sd(indt_data$correctq[indt_data$group == 1]),
            sd(indt_data$correctq[indt_data$group == 2]),
            length(indt_data$correctq[indt_data$group == 1]),
            length(indt_data$correctq[indt_data$group == 2]),
            .05)

#Contrary to the hypothesized result, the group that underwent
#hypnosis were significantly less accurate while reporting
#facts than the control group with a large effect size, t(6) = -2.66,
#p = .038, d_s = 1.88.

     d.to.r(d = -1.88, n1 = 4, n2 = 4, a = .05)
```

`d.z.mean` *d for Z-test from Population Mean and SD*

Description

This function displays d for Z-test with the population mean and standard deviation. The normal confidence interval is also provided.

Usage

```
d.z.mean(mu, m1, sig, sd1, n, a = 0.05)
```

Arguments

`mu`	population mean
`m1`	sample study mean
`sig`	population standard deviation
`sd1`	standard deviation from the study
`n`	sample size
`a`	significance level

Details

d is calculated by deducting the population mean from the sample study mean and dividing by the alpha level.

d = (m1 - mu) / sig

Learn more on our example page.

Value

The effect size (Cohen's d) with associated confidence intervals and relevant statistics.

`d`	effect size
`dlow`	lower level confidence interval d value
`dhigh`	upper level confidence interval d value
`M1`	mean of sample
`sd1`	standard deviation of sample
`se1`	standard error of sample
`M1low`	lower level confidence interval of the mean
`M1high`	upper level confidence interval of the mean
`Mu`	population mean
`Sigma`	standard deviation of population
`se2`	standard error of population
`z`	z-statistic
`p`	p-value
`n`	sample size
`estimate`	the d statistic and confidence interval in APA style for markdown printing
`statistic`	the Z-statistic in APA style for markdown printing

Examples

```
#The average quiz test taking time for a 10 item test is 22.5
#minutes, with a standard deviation of 10 minutes. My class of
#25 students took 19 minutes on the test with a standard deviation of 5.

d.z.mean(mu = 22.5, m1 = 19, sig = 10, sd1 = 5, n = 25, a = .05)
```

`d.z.z` *d from z-statistic for Z-test*

Description

This function displays d for Z-tests when all you have is the z-statistic. The normal confidence interval is also provided if you have sigma. If sigma is left blank, then you will not see a confidence interval.

Usage

```
d.z.z(z, sig = NA, n, a = 0.05)
```

Arguments

`z`	z statistic
`sig`	population standard deviation
`n`	sample size
`a`	significance level

Details

To calculate d, z is divided by the square root of N.

d = z / sqrt(N)

Learn more on our example page.

Value

The effect size (Cohen's d) with associated confidence intervals and relevant statistics.

`d`	effect size
`dlow`	lower level confidence interval d value
`dhigh`	upper level confidence interval d value
`sigma`	sample size
`z`	sig stats
`p`	p-value
`n`	sample size
`estimate`	the d statistic and confidence interval in APA style for markdown printing
`statistic`	the Z-statistic in APA style for markdown printing

Examples

```
#A recent study suggested that students (N = 100) learning
#statistics improved their test scores with the use of
#visual aids (Z = 2.5). The population standard deviation is 4.

#You can type in the numbers directly as shown below,
#or refer to your dataset within the function.

    d.z.z(z = 2.5, sig = 4, n = 100, a = .05)

    d.z.z(z = 2.5, n = 100, a = .05)

    d.z.z(2.5, 4, 100, .05)
```

`delta.ind.t` *d-delta for Between Subjects with Control Group SD Denominator*

Description

This function displays d-delta for between subjects data and the non-central confidence interval using the control group standard deviation as the denominator.

Usage

```
delta.ind.t(m1, m2, sd1, sd2, n1, n2, a = 0.05)
```

Arguments

m1	mean from control group
m2	mean from experimental group
sd1	standard deviation from control group
sd2	standard deviation from experimental group
n1	sample size from control group
n2	sample size from experimental group
a	significance level

Details

To calculate d-delta, the mean of the experimental group is subtracted from the mean of the control group, which is divided by the standard deviation of the control group.

d_delta = (m1 - m2) / sd1

Learn more on our example page.

Value

Provides the effect size (Cohen's d) with associated confidence intervals, the t-statistic, the confidence intervals associated with the means of each group, as well as the standard deviations and standard errors of the means for each group.

d	d-delta effect size
dlow	lower level confidence interval of d-delta value
dhigh	upper level confidence interval of d-delta value
M1	mean of group one
sd1	standard deviation of group one mean
se1	standard error of group one mean
M1low	lower level confidence interval of group one mean
M1high	upper level confidence interval of group one mean
M2	mean of group two
sd2	standard deviation of group two mean
se2	standard error of group two mean
M2low	lower level confidence interval of group two mean
M2high	upper level confidence interval of group two mean
spooled	pooled standard deviation
sepooled	pooled standard error
n1	sample size of group one
n2	sample size of group two
df	degrees of freedom (n1 - 1 + n2 - 1)
t	t-statistic
p	p-value
estimate	the d statistic and confidence interval in APA style for markdown printing
statistic	the t-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "indt_data" dataset, included
#in the MOTE library.

#A forensic psychologist conducted a study to examine whether
#being hypnotized during recall affects how well a witness
#can remember facts about an event. Eight participants
#watched a short film of a mock robbery, after which
#each participant was questioned about what he or she had
#seen. The four participants in the experimental group
#were questioned while they were hypnotized. The four
#participants in the control group recieved the same
#questioning without hypnosis.
```

```
    hyp = t.test(correctq ~ group, data = indt_data)

#You can type in the numbers directly, or refer to the dataset,
#as shown below.

    delta.ind.t(m1 = 17.75, m2 = 23,
               sd1 = 3.30, sd2 = 2.16,
                n1 = 4, n2 = 4, a = .05)

    delta.ind.t(17.75, 23, 3.30, 2.16, 4, 4, .05)

    delta.ind.t(mean(indt_data$correctq[indt_data$group == 1]),
            mean(indt_data$correctq[indt_data$group == 2]),
            sd(indt_data$correctq[indt_data$group == 1]),
            sd(indt_data$correctq[indt_data$group == 2]),
            length(indt_data$correctq[indt_data$group == 1]),
            length(indt_data$correctq[indt_data$group == 2]),
            .05)

#Contrary to the hypothesized result, the group that underwent hypnosis were
#significantly less accurate while reporting facts than the control group
#with a large effect size, t(6) = -2.66, p = .038, d_delta = 1.59.
```

`dept_data` *Dependent t Example Data*

Description

Dataset for use in `d.dep.t.diff`, `d.dep.t.diff.t`, `d.dep.t.avg`, and `d.dep.t.rm` exploring the before and after effects of scifi movies on supernatural beliefs.

Usage

```
data(dept_data)
```

Format

A data frame of before and after scores for rating supernatural beliefs.

before: scores rated before watching a scifi movie after: scores rated after watching a scifi movie

References

Nolan and Heizen Statistics for the Behavioral Sciences (Book Link) epsilon.full.SS *Epsilon for ANOVA from F and Sum of Squares*

Description

This function displays epsilon squared from ANOVA analyses and its non-central confidence interval based on the F distribution. This formula works for one way and multi way designs with careful focus on the sum of squares total calculation.

Usage

```
epsilon.full.SS(dfm, dfe, msm, mse, sst, a = 0.05)
```

Arguments

dfm	degrees of freedom for the model/IV/between
dfe	degrees of freedom for the error/residual/within
msm	mean square for the model/IV/between
mse	mean square for the error/residual/within
sst	sum of squares total
a	significance level

Details

To calculate epsilon, first, the mean square for the error is substracted from the mean square for the model. The difference is multiplied by the degrees of freedom for the model. The product is divided by the sum of squares total.

epsilon^2 = (dfm * (msm - mse)) / (sst)

Learn more on our example page.

Value

Provides the effect size (epsilon) with associated confidence intervals from the F-statistic.

epsilon	effect size
epsilonlow	lower level confidence interval of epsilon
epsilonhigh	upper level confidence interval of epsilon
dfm	degrees of freedom for the model/IV/between
dfe	degrees of freedom for the error/residual/within
F	F-statistic
p	p-value
estimate	the epsilon statistic and confidence interval in APA style for markdown printing
statistic	the F-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "bn1_data" dataset, included
#in the MOTE library.

#A health psychologist recorded the number of close inter-personal
#attachments of 45-year-olds who were in excellent, fair, or poor
#health. People in the Excellent Health group had 4, 3, 2, and 3
#close attachments; people in the Fair Health group had 3, 5,
#and 8 close attachments; and people in the Poor Health group
#had 3, 1, 0, and 2 close attachments.

anova_model = lm(formula = friends ~ group, data = bn1_data)
summary.aov(anova_model)

epsilon.full.SS(dfm = 2, dfe = 8, msm = 12.621,
                mse = 2.458, sst = (25.24+19.67), a = .05)
```

---

eta.F *Eta and Coefficient of Determination (R2) for ANOVA from F*

Description

This function displays eta squared from ANOVA analyses and their non-central confidence interval based on the F distribution. These values are calculated directly from F statistics and can be used for between subjects and repeated measures designs. Remember if you have two or more IVs, these values are partial eta squared.

Usage

```
eta.F(dfm, dfe, Fvalue, a = 0.05)
```

Arguments

dfm	degrees of freedom for the model/IV/between
dfe	degrees of freedom for the error/residual/within
Fvalue	F statistic
a	significance level

Details

Eta is calculated by multiplying the degrees of freedom of the model by the F-statistic. This is divided by the product of degrees of freedom of the model, the F-statistic, and the degrees of freedom for the error or residual.

eta^2 = (dfm * Fvalue) / (dfm * Fvalue + dfe)

Learn more on our example page.

Value

Provides eta with associated confidence intervals and relevant statistics.

`eta`	effect size
`etalow`	lower level confidence interval of eta
`etahigh`	upper level confidence interval of eta
`dfm`	degrees of freedom for the model/IV/between
`dfe`	degrees of freedom for the error/resisual/within
`F`	F-statistic
`p`	p-value
`estimate`	the eta squared statistic and confidence interval in APA style for markdown printing
`statistic`	the F-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "bn1_data" dataset, included
#in the MOTE library.

#A health psychologist recorded the number of close inter-personal
#attachments of 45-year-olds who were in excellent, fair, or poor
#health. People in the Excellent Health group had 4, 3, 2, and 3
#close attachments; people in the Fair Health group had 3, 5,
#and 8 close attachments; and people in the Poor Health group
#had 3, 1, 0, and 2 close attachments.

anova_model = lm(formula = friends ~ group, data = bn1_data)
summary.aov(anova_model)

eta.F(dfm = 2, dfe = 8,
      Fvalue = 5.134, a = .05)
```

`eta.full.SS` *Eta for ANOVA from F and Sum of Squares*

Description

This function displays eta squared from ANOVA analyses and its non-central confidence interval based on the F distribution. This formula works for one way and multi way designs with careful focus on the sum of squares total.

Usage

```
eta.full.SS(dfm, dfe, ssm, sst, Fvalue, a = 0.05)
```

Arguments

dfm	degrees of freedom for the model/IV/between
dfe	degrees of freedom for the error/residual/within
ssm	sum of squares for the model/IV/between
sst	sum of squares total
Fvalue	F statistic
a	significance level

Details

Eta squared is calculated by dividing the sum of squares for the model by the sum of squares total.

eta^2 = ssm / sst

Learn more on our example page.

Value

Provides eta with associated confidence intervals and relevant statistics.

eta	effect size
etalow	lower level confidence interval of eta
etahigh	upper level confidence interval of eta
dfm	degrees of freedom for the model/IV/between
dfe	degrees of freedom for the error/resisual/within
F	F-statistic
p	p-value
estimate	the eta squared statistic and confidence interval in APA style for markdown printing
statistic	the F-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "bn1_data" dataset, included
#in the MOTE library.

#A health psychologist recorded the number of close inter-personal
#attachments of 45-year-olds who were in excellent, fair, or poor
#health. People in the Excellent Health group had 4, 3, 2, and 3
#close attachments; people in the Fair Health group had 3, 5,
#and 8 close attachments; and people in the Poor Health group
#had 3, 1, 0, and 2 close attachments.

anova_model = lm(formula = friends ~ group, data = bn1_data)
summary.aov(anova_model)

eta.full.SS(dfm = 2, dfe = 8, ssm = 25.24,
            sst = (25.24+19.67), Fvalue = 5.134, a = .05)
```

`eta.partial.SS` *Partial Eta Squared for ANOVA from F and Sum of Squares*

Description

This function displays partial eta squared from ANOVA analyses and its non-central confidence interval based on the F distribution. This formula works for one way and multi way designs.

Usage

```
eta.partial.SS(dfm, dfe, ssm, sse, Fvalue, a = 0.05)
```

Arguments

`dfm`	degrees of freedom for the model/IV/between
`dfe`	degrees of freedom for the error/residual/within
`ssm`	sum of squares for the model/IV/between
`sse`	sum of squares for the error/residual/within
`Fvalue`	F statistic
`a`	significance level

Details

Partial eta squared is calculated by dividing the sum of squares of the model by the sum of the sum of squares of the model and sum of squares of the error.

partial eta^2 = ssm / (ssm + sse)

Learn more on our example page.

Value

Provides partial eta squared with associated confidence intervals and relevant statistics.

`eta`	partial eta squared effect size
`etalow`	lower level confidence interval of partial eta squared
`etahigh`	upper level confidence interval of partial eta squared
`dfm`	degrees of freedom for the model/IV/between
`dfe`	degrees of freedom for the error/resisual/within
`F`	F-statistic
`p`	p-value
`estimate`	the eta squared statistic and confidence interval in APA style for markdown printing
`statistic`	the F-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "bn2_data" dataset, included
#in the MOTE library.

#Is there a difference in atheletic spending budget for different sports?
#Does that spending interact with the change in coaching staff? This data includes
#(fake) atheletic budgets for baseball, basketball, football, soccer, and volleyball teams
#with new and old coaches to determine if there are differences in
#spending across coaches and sports.

library(ez)
bn2_data$partno = 1:nrow(bn2_data)
anova_model = ezANOVA(data = bn2_data,
                      dv = money,
                      wid = partno,
                      between = .(coach, type),
                      detailed = TRUE,
                      type = 3)

#You would calculate one eta for each F-statistic.
#Here's an example for the interaction with typing in numbers.
eta.partial.SS(dfm = 4, dfe = 990,
               ssm = 338057.9, sse = 32833499,
               Fvalue = 2.548, a = .05)

#Here's an example for the interaction with code.
eta.partial.SS(dfm = anova_model$ANOVA$DFn[4],
               dfe = anova_model$ANOVA$DFd[4],
               ssm = anova_model$ANOVA$SSn[4],
               sse = anova_model$ANOVA$SSd[4],
               Fvalue =  anova_model$ANOVA$F[4],
               a = .05)
```

`g.ind.t` *d-g Corrected for Independent t*

Description

This function displays d-g corrected and the non-central confidence interval for independent t.

Usage

```
g.ind.t(m1, m2, sd1, sd2, n1, n2, a = 0.05)
```

Arguments

m1	mean group one
m2	mean group two

sd1	standard deviation group one
sd2	standard deviation group two
n1	sample size group one
n2	sample size group two
a	significance level

Details

The correction is calculated by dividing three by the sum of both sample sizes after multiplying by four and subtracting nine. This amount is deducted from one.

correction = 1 - (3 / (4 * (n1 + n2) - 9))

D-g corrected is calculated by substracting mean two from mean one, dividing by the pooled standard deviation which is multiplied by the correction above.

d_g corrected = ((m1 - m2) / spooled) * correction

Learn more on our example page.

Value

D-g corrected with associated confidence intervals, the confidence intervals associated with the means of each group, standard deviations of the means for each group, relevant statistics.

d	d-g corrected effect size
dlow	lower level confidence interval d-g corrected
dhigh	upper level confidence interval d-g corrected
M1	mean group one
sd1	standard deviation of group one
se1	standard error of group one
M1low	lower level confidence interval of mean one
M1high	upper level confidence interval of mean one
M2	mean two
sd2	standard deviation of mean two
se1	standard error of mean two
M2low	lower level confidence interval of mean two
M2high	upper level confidence interval of mean two
spooled	pooled standard deviation
sepooled	pooled standard error
correction	g corrected
n1	size of sample one
n2	size of sample two
df	degrees of freedom
t	t-statistic
p	p-value
estimate	the d statistic and confidence interval in APA style for markdown printing
statistic	the t-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "indt_data" dataset, included
#in the MOTE library.

#A forensic psychologist conducted a study to examine whether
#being hypnotized during recall affects how well a witness
#can remember facts about an event. Eight participants
#watched a short film of a mock robbery, after which
#each participant was questioned about what he or she had
#seen. The four participants in the experimental group
#were questioned while they were hypnotized. The four
#participants in the control group recieved the same
#questioning without hypnosis.

    t.test(correctq ~ group, data = indt_data)

#You can type in the numbers directly, or refer to the dataset,
#as shown below.

    g.ind.t(m1 = 17.75, m2 = 23, sd1 = 3.30,
           sd2 = 2.16, n1 = 4, n2 = 4, a = .05)

    g.ind.t(17.75, 23, 3.30, 2.16, 4, 4, .05)

    g.ind.t(mean(indt_data$correctq[indt_data$group == 1]),
            mean(indt_data$correctq[indt_data$group == 2]),
            sd(indt_data$correctq[indt_data$group == 1]),
            sd(indt_data$correctq[indt_data$group == 2]),
            length(indt_data$correctq[indt_data$group == 1]),
            length(indt_data$correctq[indt_data$group == 2]),
            .05)

#Contrary to the hypothesized result, the group that underwent hypnosis were
#significantly less accurate while reporting facts than the control group
#with a large effect size, t(6) = -2.66, p = .038, d_g = 1.64.
```

`ges.partial.SS.mix` *Partial Generalized Eta-Squared for Mixed Design ANOVA from F*

Description

This function displays partial generalized eta-squared (GES) from ANOVA analyses and its non-central confidence interval based on the F distribution. This formula works for mixed designs.

Usage

```
ges.partial.SS.mix(dfm, dfe, ssm, sss, sse, Fvalue, a = 0.05)
```

Arguments

`dfm`	degrees of freedom for the model/IV/between
`dfe`	degrees of freedom for the error/residual/within
`ssm`	sum of squares for the model/IV/between
`sss`	sum of squares subject variance
`sse`	sum of squares for the error/residual/within
`Fvalue`	F statistic
`a`	significance level

Details

To calculate partial generalized eta squared, first, the sum of squares of the model, sum of squares of the subject variance, sum of squares for the subject variance, and the sum of squares for the error/residual/within are added together. The sum of squares of the model is divided by this value.

partial ges = ssm / (ssm + sss + sse)

Learn more on our example page.

Value

Partial generalized eta-squared (GES) with associated confidence intervals and relevant statistics.

`ges`	effect size
`geslow`	lower level confidence interval for ges
`geshigh`	upper level confidence interval for ges
`dfm`	degrees of freedom for the model/IV/between
`dfe`	degrees of freedom for the error/residual/within
`F`	F-statistic
`p`	p-value
`estimate`	the generalized eta squared statistic and confidence interval in APA style for markdown printing
`statistic`	the F-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "mix2_data" dataset, included
#in the MOTE library.

#Given previous research, we know that backward strength in free
#association tends to increase the ratings participants give when
#you ask them how many people out of 100 would say a word in
#response to a target word (like Family Feud). This result is
#tied to people's overestimation of how well they think they know
#something, which is bad for studying. So, we gave people instructions
#on how to ignore the BSG.  Did it help? Is there an interaction
```

```
#between BSG and instructions given?

library(ez)
mix2_data$partno = 1:nrow(mix2_data)

library(reshape)
long_mix = melt(mix2_data, id = c("partno", "group"))

anova_model = ezANOVA(data = long_mix,
                      dv = value,
                      wid = partno,
                      between = group,
                      within = variable,
                      detailed = TRUE,
                      type = 3)

#You would calculate one partial GES value for each F-statistic.
#Here's an example for the interaction with typing in numbers.
ges.partial.SS.mix(dfm = 1, dfe = 156,
                   ssm = 71.07608,
                   sss = 30936.498,
                   sse = 8657.094,
                   Fvalue = 1.280784, a = .05)

#Here's an example for the interaction with code.
ges.partial.SS.mix(dfm = anova_model$ANOVA$DFn[4],
               dfe = anova_model$ANOVA$DFd[4],
               ssm = anova_model$ANOVA$SSn[4],
               sss = anova_model$ANOVA$SSd[1],
               sse = anova_model$ANOVA$SSd[4],
               Fvalue =  anova_model$ANOVA$F[4],
               a = .05)
```

`ges.partial.SS.rm` *Partial Generalized Eta-Squared for ANOVA from F*

Description

This function displays partial ges squared from ANOVA analyses and its non-central confidence interval based on the F distribution. This formula works for multi-way repeated measures designs.

Usage

```
ges.partial.SS.rm(dfm, dfe, ssm, sss, sse1, sse2, sse3, Fvalue, a = 0.05)
```

Arguments

`dfm`	degrees of freedom for the model/IV/between
`dfe`	degrees of freedom for the error/residual/within

`ssm`	sum of squares for the model/IV/between
`sss`	sum of squares subject variance
`sse1`	sum of squares for the error/residual/within for the first IV
`sse2`	sum of squares for the error/residual/within for the second IV
`sse3`	sum of squares for the error/residual/within for the interaction
`Fvalue`	F statistic
`a`	significance level

Details

To calculate partial generalized eta squared, first, the sum of squares of the model, sum of squares of the subject variance, sum of squares for the first and second independent variables, and the sum of squares for the interaction are added together. The sum of squares of the model is divided by this value.

partial ges <- ssm / (ssm + sss + sse1 + sse2 + sse3)

Learn more on our example page.

Value

Partial generalized eta-squared (GES) with associated confidence intervals and relevant statistics.

`ges`	effect size
`geslow`	lower level confidence interval for ges
`geshigh`	upper level confidence interval for ges
`dfm`	degrees of freedom for the model/IV/between
`dfe`	degrees of freedom for the error/residual/within
`F`	F-statistic
`p`	p-value
`estimate`	the generalized eta squared statistic and confidence interval in APA style for markdown printing
`statistic`	the F-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "rm2_data" dataset, included
#in the MOTE library.

#In this experiment people were given word pairs to rate based on
#their "relatedness". How many people out of a 100 would put LOST-FOUND
#together? Participants were given pairs of words and asked to rate them
#on how often they thought 100 people would give the second word if shown
#the first word.  The strength of the word pairs was manipulated through
#the actual rating (forward strength: FSG) and the strength of the reverse
#rating (backward strength: BSG). Is there an interaction between FSG and
```

```
#BSG when participants are estimating the relation between word pairs?

library(ez)
library(reshape)
long_mix = melt(rm2_data, id = c("subject", "group"))
long_mix$FSG = c(rep("Low-FSG", nrow(rm2_data)),
                 rep("High-FSG", nrow(rm2_data)),
                 rep("Low-FSG", nrow(rm2_data)),
                 rep("High-FSG", nrow(rm2_data)))
long_mix$BSG = c(rep("Low-BSG", nrow(rm2_data)*2),
                 rep("High-BSG", nrow(rm2_data)*2))

anova_model = ezANOVA(data = long_mix,
                      dv = value,
                      wid = subject,
                      within = .(FSG, BSG),
                      detailed = TRUE,
                      type = 3)

#You would calculate one partial GES value for each F-statistic.
#Here's an example for the interaction with typing in numbers.
ges.partial.SS.rm(dfm = 1, dfe = 157,
                  ssm = 2442.948, sss = 76988.13,
                  sse1 = 5402.567, sse2 = 8318.75, sse3 = 6074.417,
                  Fvalue = 70.9927, a = .05)

#Here's an example for the interaction with code.
ges.partial.SS.rm(dfm = anova_model$ANOVA$DFn[4],
                  dfe = anova_model$ANOVA$DFd[4],
                  ssm = anova_model$ANOVA$SSn[4],
                  sss = anova_model$ANOVA$SSd[1],
                  sse1 = anova_model$ANOVA$SSd[4],
                  sse2 = anova_model$ANOVA$SSd[2],
                  sse3 = anova_model$ANOVA$SSd[3],
                  Fvalue = anova_model$ANOVA$F[4],
                  a = .05)
```

---

indt_data *Independent t Example Data*

Description

Dataset for use in d.ind.t, d.ind.t.t, delta.ind.t exploring the effects of hypnotism on the effects of recall after witnessing a crime.

Usage

```
data(indt_data)
```

Format

A data frame including two groups, one recieving a hypnotism intervention, and one control group, to determine how hypnotism effects recall after witnessing a crime.

`mix2_data` *Mixed Two-way ANOVA Example Data*

Description

Dataset for use in `ges.partial.SS.mix`. Given previous research, we know that backward strength in free association tends to increase the ratings participants give when you ask them how many people out of 100 would say a word in response to a target word (like Family Feud). This result is tied to people's overestimation of how well they think they know something, which is bad for studying. So, we gave people instructions on how to ignore the BSG. Did it help? Is there an interaction between BSG and instructions given?

Usage

```
data(mix2_data)
```

Format

A data frame including group type and backward strength rating.

group: Regular JAM Task or Debiasing JAM task bsglo: estimate of response to target word in a Low BSG condition bsghi: estimate of response to target word in a High BSG condition

---

`odds` *Chi-Square Odds Ratios*

Description

This function displays odds ratios and their normal confidence intervals.

Usage

```
odds(n11, n12, n21, n22, a = 0.05)
```

Arguments

`n11`	sample size for level 1.1
`n12`	sample size for level 1.2
`n21`	sample size for level 2.1
`n22`	sample size for level 2.2
`a`	significance level

Details

This statistic is the ratio between level 1.1 divided by level 1.2, and level 2.1 divided by 2.2. In other words, these are the odds of level 1.1 given level 1 overall versus level 2.1 given level 2 overall.

To calculate odds ratios, First, the sample size for level 1.1 is divided by the sample size for level 1.2. This value is divided by the sample size for level 2.1, after dividing by the sample size of level 2.2.

odds <- (n11 / n12) / (n21 / n22)

Learn more on our example page.

Value

Provides odds ratios with associated confidence intervals and relevant statistics.

`odds`	odds statistic
`olow`	lower level confidence interval of odds statistic
`ohigh`	upper level confidence interval of odds statistic
`se`	standard error
`estimate`	the oods statistic and confidence interval in APA style for markdown printing

Examples

```
#A health psychologist was interested in the rates of anxiety in
#first generation and regular college students. They polled campus
#and found the following data:

  #|              | First Generation | Regular |
  #|--------------|------------------|---------|
  #| Low Anxiety  | 10               | 50      |
  #| High Anxiety | 20               | 15      |

#What are the odds for the first generation students to have anxiety?

odds(n11 = 10, n12 = 50, n21 = 20, n22 = 15, a = .05)
```

`omega.F` *Omega Squared for ANOVA from F*

Description

This function displays omega squared from ANOVA analyses and its non-central confidence interval based on the F distribution. These values are calculated directly from F statistics and can be used for between subjects and repeated measures designs. Remember if you have two or more IVs, these values are partial omega squared.

Usage

```
omega.F(dfm, dfe, Fvalue, n, a = 0.05)
```

Arguments

dfm	degrees of freedom for the model/IV/between
dfe	degrees of freedom for the error/residual/within
Fvalue	F statistic
n	full sample size
a	significance level

Details

Omega squared or partial omega squared is calculated by subtracting one from the F-statistic and multiplying it by degrees of freedom of the model. This is divided by the same value after adding the number of valid responses. This value will be omega squared for one-way ANOVA designs, and will be partial omega squared for multi-way ANOVA designs (i.e. with more than one IV).

omega^2 = (dfm * (Fvalue-1)) / ((dfm * (Fvalue-1)) + n)

Learn more on our example page.

Value

The effect size (Cohen's d) with associated confidence intervals and relevant statistics.

omega	omega statistic
omegalow	lower level confidence interval d value
omegahigh	upper level confidence interval d value
dfm	degrees of freedom for the model/IV/between
dfe	degrees of freedom for the error/residual/within
F	F-statistic
p	p-value
estimate	the omega squared statistic and confidence interval in APA style for markdown printing
statistic	the F-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "bn1_data" dataset, included
#in the MOTE library.

#A health psychologist recorded the number of close inter-personal
#attachments of 45-year-olds who were in excellent, fair, or poor
#health. People in the Excellent Health group had 4, 3, 2, and 3
#close attachments; people in the Fair Health group had 3, 5,
```

```
#and 8 close attachments; and people in the Poor Health group
#had 3, 1, 0, and 2 close attachments.

anova_model = lm(formula = friends ~ group, data = bn1_data)
summary.aov(anova_model)

omega.F(dfm = 2, dfe = 8,
      Fvalue = 5.134, n = 11, a = .05)
```

---

omega.full.SS *Omega Squared for One-Way and Multi-Way ANOVA from F*

Description

This function displays omega squared from ANOVA analyses and its non-central confidence interval based on the F distribution. This formula works for one way and multi way designs with careful focus on which error term you are using for the calculation.

Usage

```
omega.full.SS(dfm, dfe, msm, mse, sst, a = 0.05)
```

Arguments

`dfm`	degrees of freedom for the model/IV/between
`dfe`	degrees of freedom for the error/residual/within
`msm`	mean square for the model/IV/between
`mse`	mean square for the error/residual/within
`sst`	sum of squares total
`a`	significance level

Details

Omega squared is calculated by deducting the mean square of the error from the mean square of the model and multiplying by the degrees of freedom for the model. This is divided by the sum of the sum of squares total and the mean square of the error.

omega = (dfm * (msm - mse)) / (sst + mse)

Learn more on our example page.

Value

Provides omega squared with associated confidence intervals and relevant statistics.

`omega`	omega squared
`omegalow`	lower level confidence interval of omega
`omegahigh`	upper level confidence interval of omega

dfm	degrees of freedom for the model/IV/between
dfe	degrees of freedom for the error/resisual/within
F	F-statistic
p	p-value
estimate	the omega squared statistic and confidence interval in APA style for markdown printing
statistic	the F-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "bn1_data" dataset, included
#in the MOTE library.

#A health psychologist recorded the number of close inter-personal
#attachments of 45-year-olds who were in excellent, fair, or poor
#health. People in the Excellent Health group had 4, 3, 2, and 3
#close attachments; people in the Fair Health group had 3, 5,
#and 8 close attachments; and people in the Poor Health group
#had 3, 1, 0, and 2 close attachments.

anova_model = lm(formula = friends ~ group, data = bn1_data)
summary.aov(anova_model)

omega.full.SS(dfm = 2, dfe = 8,
              msm = 12.621, mse = 2.548,
              sst = (25.54+19.67), a = .05)
```

---

omega.gen.SS.rm *Generalized Omega Squared for Multi-Way and Mixed ANOVA from F*

Description

This function displays generalized omega squared from ANOVA analyses and its non-central confidence interval based on the F distribution. This formula is appropriate for multi-way repeated measures designs and mix level designs.

Usage

```
omega.gen.SS.rm(dfm, dfe, ssm, ssm2, sst, mss, j, Fvalue, a = 0.05)
```

Arguments

dfm	degrees of freedom for the model/IV/between
dfe	degrees of freedom for the error/residual/within
ssm	sum of squares for the MAIN model/IV/between

`ssm2`	sum of squares for the OTHER model/IV/between
`sst`	sum of squares total across the whole ANOVA
`mss`	mean square for the subject variance
`j`	number of levels in the OTHER IV
`Fvalue`	F statistic from the output for your IV
`a`	significance level

Details

Omega squared is calculated by subtracting the product of the degrees of freedom of the model and the mean square of the subject variance from the sum of squares for the model.

This is divided by the value obtained after combining the sum of squares total, sum of squares for the other independent variable, and the mean square of the subject variance multiplied by the number of levels in the other model/IV/between.

generalized omega^2 = (ssm - (dfm * mss)) / (sst + ssm2 + j*mss)

Learn more on our example page.

Value

Provides omega squared with associated confidence intervals and relevant statistics.

`omega`	omega squared
`omegalow`	lower level confidence interval of omega
`omegahigh`	upper level confidence interval of omega
`dfm`	degrees of freedom for the model/IV/between
`dfe`	degrees of freedom for the error/resisual/within
`F`	F-statistic
`p`	p-value
`estimate`	the omega squared statistic and confidence interval in APA style for markdown printing
`statistic`	the F-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "mix2_data" dataset, included
#in the MOTE library.

#Given previous research, we know that backward strength in free
#association tends to increase the ratings participants give when
#you ask them how many people out of 100 would say a word in
#response to a target word (like Family Feud). This result is
#tied to people's overestimation of how well they think they know
#something, which is bad for studying. So, we gave people instructions
#on how to ignore the BSG.  Did it help? Is there an interaction
```

```
#between BSG and instructions given?

library(ez)
mix2_data$partno = 1:nrow(mix2_data)

library(reshape)
long_mix = melt(mix2_data, id = c("partno", "group"))

anova_model = ezANOVA(data = long_mix,
                      dv = value,
                      wid = partno,
                      between = group,
                      within = variable,
                      detailed = TRUE,
                      type = 3)

#You would calculate one partial GOS value for each F-statistic.
#Here's an example for the main effect 1 with typing in numbers.
 omega.gen.SS.rm(dfm = 1, dfe = 156,
                 ssm = 6842.46829,
                 ssm2 = 14336.07886,
                 sst = sum(c(30936.498, 6842.46829,
                 14336.07886, 8657.094, 71.07608)),
                 mss = 30936.498 / 156,
                 j = 2, Fvalue = 34.503746, a = .05)

#Here's an example for the main effect 1 with code.
 omega.gen.SS.rm(dfm = anova_model$ANOVA$DFn[2],
                 dfe = anova_model$ANOVA$DFd[2],
                 ssm = anova_model$ANOVA$SSn[2],
                 ssm2 = anova_model$ANOVA$SSn[3],
                 sst = sum(c(anova_model$ANOVA$SSn[-1], anova_model$ANOVA$SSd[c(1,3)])),
                 mss = anova_model$ANOVA$SSd[1]/anova_model$ANOVA$DFd[1],
                 j = anova_model$ANOVA$DFn[3]+1,
                 Fvalue = anova_model$ANOVA$F[2], a = .05)
```

`omega.partial.SS.bn` *Partial Omega Squared for Between Subjects ANOVA from F*

Description

This function displays omega squared from ANOVA analyses and its non-central confidence interval based on the F distribution. This formula is appropriate for multi-way between subjects designs.

Usage

```
omega.partial.SS.bn(dfm, dfe, msm, mse, ssm, n, a = 0.05)
```

Arguments

`dfm`	degrees of freedom for the model/IV/between
`dfe`	degrees of freedom for the error/residual/within
`msm`	mean square for the model/IV/between
`mse`	mean square for the error/residual/within
`ssm`	sum of squares for the model/IV/between
`n`	total sample size
`a`	significance level

Details

Partial omega squared is calculated by subtracting the mean square for the error from the mean square of the model, which is multiplied by degrees of freedom of the model. This is divided by the product of the degrees of freedom for the model are deducted from the sample size, multiplied by the mean square of the error, plus the sum of squares for the model.

omega^2 <- (dfm * (msm - mse)) / (ssm + (n-dfm)*mse)

Learn more on our example page.

Value

Provides omega squared with associated confidence intervals and relevant statistics.

`omega`	omega squared
`omegalow`	lower level confidence interval of omega
`omegahigh`	upper level confidence interval of omega
`dfm`	degrees of freedom for the model/IV/between
`dfe`	degrees of freedom for the error/resisual/within
`F`	F-statistic
`p`	p-value
`estimate`	the omega squared statistic and confidence interval in APA style for markdown printing
`statistic`	the F-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "bn2_data" dataset, included
#in the MOTE library.

#Is there a difference in atheletic spending budget for different sports?
#Does that spending interact with the change in coaching staff? This data includes
#(fake) atheletic budgets for baseball, basketball, football, soccer, and volleyball teams
#with new and old coaches to determine if there are differences in
#spending across coaches and sports.
```

```
library(ez)
bn2_data$partno = 1:nrow(bn2_data)
anova_model = ezANOVA(data = bn2_data,
                      dv = money,
                      wid = partno,
                      between = .(coach, type),
                      detailed = TRUE,
                      type = 3)

#You would calculate one eta for each F-statistic.
#Here's an example for the interaction with typing in numbers.
omega.partial.SS.bn(dfm = 4, dfe = 990,
                    msm = 338057.9 / 4,
                    mse = 32833499 / 990,
                    ssm = 338057.9,
                    n = 1000, a = .05)

#Here's an example for the interaction with code.
omega.partial.SS.bn(dfm = anova_model$ANOVA$DFn[4],
                    dfe = anova_model$ANOVA$DFd[4],
                    msm = anova_model$ANOVA$SSn[4] / anova_model$ANOVA$DFn[4],
                    mse = anova_model$ANOVA$SSd[4] / anova_model$ANOVA$DFd[4],
                    ssm = anova_model$ANOVA$SSn[4],
                    n = nrow(bn2_data),
                    a = .05)
```

`omega.partial.SS.rm` *Partial Omega Squared for Repeated Measures ANOVA from F*

Description

This function displays omega squared from ANOVA analyses and its non-central confidence interval based on the F distribution. This formula is appropriate for multi-way repeated measures designs and mix level designs.

Usage

```
omega.partial.SS.rm(dfm, dfe, msm, mse, mss, ssm, sse, sss, a = 0.05)
```

Arguments

dfm	degrees of freedom for the model/IV/between
dfe	degrees of freedom for the error/residual/within
msm	mean square for the model/IV/between
mse	mean square for the error/residual/within
mss	mean square for the subject variance
ssm	sum of squares for the model/IV/between

`sse`	sum of squares for the error/residual/within
`sss`	sum of squares for the subject variance
`a`	significance level

Details

Partial omega squared is calculated by subtracting the mean square for the error from the mean square of the model, which is multiplied by degrees of freedom of the model. This is divided by the sum of the sum of squares for the model, sum of squares for the error, sum of squares for the subject, and the mean square of the subject.

omega_p^2 = (dfm x (msm - mse)) / (ssm + sse + sss + mss)

The F-statistic is calculated by dividing the mean square of the model by the mean square of the error.

F = msm / mse

Learn more on our example page.

Value

Provides omega squared with associated confidence intervals and relevant statistics.

`omega`	omega squared
`omegalow`	lower level confidence interval of omega
`omegahigh`	upper level confidence interval of omega
`dfm`	degrees of freedom for the model/IV/between
`dfe`	degrees of freedom for the error/resisual/within
`F`	F-statistic
`p`	p-value
`estimate`	the omega squared statistic and confidence interval in APA style for markdown printing
`statistic`	the F-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "rm2_data" dataset, included
#in the MOTE library.

#In this experiment people were given word pairs to rate based on
#their "relatedness". How many people out of a 100 would put LOST-FOUND
#together? Participants were given pairs of words and asked to rate them
#on how often they thought 100 people would give the second word if shown
#the first word.  The strength of the word pairs was manipulated through
#the actual rating (forward strength: FSG) and the strength of the reverse
#rating (backward strength: BSG). Is there an interaction between FSG and
#BSG when participants are estimating the relation between word pairs?
```

```
library(ez)
library(reshape)
long_mix = melt(rm2_data, id = c("subject", "group"))
long_mix$FSG = c(rep("Low-FSG", nrow(rm2_data)),
                 rep("High-FSG", nrow(rm2_data)),
                 rep("Low-FSG", nrow(rm2_data)),
                 rep("High-FSG", nrow(rm2_data)))
long_mix$BSG = c(rep("Low-BSG", nrow(rm2_data)*2),
                 rep("High-BSG", nrow(rm2_data)*2))

anova_model = ezANOVA(data = long_mix,
                      dv = value,
                      wid = subject,
                      within = .(FSG, BSG),
                      detailed = TRUE,
                      type = 3)

#You would calculate one partial GOS value for each F-statistic.
#You can leave out the MS options if you include all the SS options.
#Here's an example for the interaction with typing in numbers.
omega.partial.SS.rm(dfm = 1, dfe = 157,
                    msm = 2442.948 / 1,
                    mse = 5402.567 / 157,
                    mss = 76988.130 / 157,
                    ssm = 2442.948, sss = 76988.13,
                    sse = 5402.567, a = .05)

#Here's an example for the interaction with code.
omega.partial.SS.rm(dfm = anova_model$ANOVA$DFn[4],
                  dfe = anova_model$ANOVA$DFd[4],
                  msm = anova_model$ANOVA$SSn[4] / anova_model$ANOVA$DFn[4],
                  mse = anova_model$ANOVA$SSd[4] / anova_model$ANOVA$DFd[4],
                  mss = anova_model$ANOVA$SSd[1] / anova_model$ANOVA$DFd[1],
                  ssm = anova_model$ANOVA$SSn[4],
                  sse = anova_model$ANOVA$SSd[4],
                  sss = anova_model$ANOVA$SSd[1],
                  a = .05)
```

`r.correl` *r to Coefficient of Determination (R2) from F*

Description

This function displays transformation from r to r2 to calculate the non-central confidence interval for r2 using the F distribution.

Usage

```
r.correl(r, n, a = 0.05)
```

Arguments

`r`	correlation coefficient
`n`	sample size
`a`	significance level

Details

The t-statistic is calculated by first dividing one minus the square root of r squared by degrees of freedom of the error. r is divided by this value.

t = r / sqrt((1 - rsq) / (n - 2))

The F-statistic is the t-statistic squared.

Fvalue = t ^ 2

Learn more on our example page.

Value

Provides correlation coefficient and coefficient of determination with associated confidence intervals and relevant statistics.

`r`	correlation coefficient
`rlow`	lower level confidence interval r
`rhigh`	upper level confidence interval r
`R2`	coefficient of determination
`R2low`	lower level confidence interval of R2
`R2high`	upper level confidence interval of R2
`se`	standard error
`n`	sample size
`dfm`	degrees of freedom of mean
`dfe`	degrees of freedom of error
`t`	t-statistic
`F`	F-statistic
`p`	p-value
`estimate`	the r statistic and confidence interval in APA style for markdown printing
`estimateR2`	the R^2 statistic and confidence interval in APA style for markdown printing
`statistic`	the t-statistic in APA style for markdown printing

Examples

```
#This example is derived from the mtcars dataset provided in R.

#What is the correlation between miles per gallon and car weight?

cor.test(mtcars$mpg, mtcars$wt)

r.correl(r = -0.8676594, n = 32, a = .05)
```

---

rm1_data *Repeated Measures Oneway ANOVA Example Data*

Description

Dataset for use in omega.F. Participants were tested over several days to measure variations in their pulse given different types of stimuli. One stimulus was a neutral picture (like a toaster), while other stimuli were cute/happy pictures (puppies, babies), and negative stimuli (mutilated faces, pictures of war). Were there differences in pulse for each participant across the stimuli?

Usage

```
data(rm1_data)
```

Format

A data frame including ratings toward pictures.

neutral: pulse during exposure to neutral stimuli positive: pulse during exposure to positive stimuli negative: pulse during exposure to negative stimuli

---

rm2_data *Repeated Measures Two-way ANOVA Example Data*

Description

Dataset for use in omega.partial.SS.rm and other repeated measures ANOVA designs. This dataset includes a group variable used for mixed repeated measures designs, a subject number, and two repeated measures variables. These variables include FSG (forward strength) which is a measure of the relation between two words like cheddar to cheese. The second variable is BSG (backward strength), which is the opposite relation (cheese to cheddar). Participants rated those word pairs in and the strength of FSG and BSG was manipulated to measure overestimation of strength.

Usage

```
data(rm2_data)
```

Format

A data frame of ratings of word pair relation

group: A between-subjects variable indicating the type of instructions subject: A subject number fsglobsglo: A repeated measures condition of low FSG-BSG fsghihbsglo: A repeated measures condition of high FSG, low BSG fsglobsghi: A repeated measures condition of low FSG, high BSG fsghibsghi: A repeated measures condition of high FSG-BSG

---

singt_data *Single Sample t Example Data*

Description

A simulated dataset for use in `d.single.t` and `d.single.t.t`, including gifted/honors student SAT scores from a specific school to use for comparison with the national average SAT score (1080) of gifted/honors students nationwide.

Usage

```
data(singt_data)
```

Format

A data frame including a single sample consisting of SAT scores of students from a gifted/honors program at a specific school.

---

v.chi.sq *V for Chi-Square*

Description

This function displays V and non-central confidence interval for the specified chi-square statistic.

Usage

```
v.chi.sq(x2, n, r, c, a = 0.05)
```

Arguments

x2	chi-square statistic
n	sample size
r	number of rows in the contingency table
c	number of columns in the contingency table
a	significance level

Details

V is calculated by finding the square root of chi-squared divided by the product of the sample size and the degrees of freedom with the lowest value.

v = sqrt(x2 / (n * dfsmall))

Learn more on our example page.

Value

Provides V with associated confidence intervals and relevant statistics.

`v`	v-statistic
`vlow`	lower level confidence interval of omega
`vhigh`	upper level confidence interval of omega
`n`	sample size
`df`	degrees of freedom
`x2`	significance statistic
`p`	p-value
`estimate`	the V statistic and confidence interval in APA style for markdown printing
`statistic`	the X2-statistic in APA style for markdown printing

Examples

```
#The following example is derived from the "chisq_data" dataset, included
#in the MOTE library.

#Individuals were polled about their number of friends (low, medium, high)
#and their number of kids (1, 2, 3+) to determine if there was a
#relationship between friend groups and number of children, as we
#might expect that those with more children may have less time for
#friendship maintaining activities.

chisq.test(chisq_data$kids, chisq_data$friends)

v.chi.sq(x2 = 2.0496, n = 60, r = 3, c = 3, a = .05)

#Please note, if you see a warning, that implies the lower effect should
#be zero, as noted.
```

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